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DETERMINATION OF THE AGE OF THE RIVER BEAVER

by L.S. Lavrov

(Bibliographical reference: Lavrov, L.S. Opredeleniye Vozrasta Rechnykh Bobrov. Trudy Voronezhskogo Gosudarstvennogo Zapovednika. Vypusk IV. - Voronezhskoye Knizhnoye Izdatelstovo, 1953. p. 77.)

The reproductive capacity of animals in many respects depends on their age: young females, as a rule, are less proliferous, the offspring of aging parents are weaker, etc. The reproductive capacity of the males, which varies with the species, is also closely connected with their age. It is very important for us to know the age of an organism.

From the time of organization of the Voronezh Sanctuary, we were in need of a method of determining the age of beavers. In 1932 this problem became especially urgent when the first group of wild beavers was caught to form an experimental farm. At first the practical workers who caught the animals introduced three age categories depending on the general size of the animal (the size was determined by sight), namely: young, half-grown and adult.

This was fully justified and correct, as a large beaver family always consists of adults and of the young of that year and of the year before. But later it appeared that most beavers reach sexual maturity only toward the age of three. Unable in practice to distinguish these confusing age groups, they started to place in the "half-grown" group all animals aged over one year but without a mate.

The necessity of determining accurately the age of beavers arose again, and to a greater extent, from the moment of the organization of wholesale catches of the animals for acclimatization in other regions of the Soviet Union.

At present, due to extensive annual thinning out of beavers by whole families, we already have at our disposal much material for the determination of the age of beavers. Since 1935, nearly 1,200 beavers have been caught and measured, including 360 cubs, 180 yearlings, 200 two-year-olds, 180 three-year-olds and 280 fully grown animals.

Animals aged three years are larger than two-year-olds, but smaller than fully grown beavers. The difference between them and fully grown individuals gradually levels off, but some discrepancy still remains. Biologically speaking, the three-year-old beavers are individuals who have mostly found their mates and live a more or less settled life, but they may have no offspring; if they have, there will not be more than one or two. There are, of course, no yearlings in such a family.

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In addition to the material obtained by catches, the data from experimental beaver farms were of great help for the comparison and confirmation of the established age groups, if the farms contained beavers of various ages (17 years old and younger), born and brought up under supervision. There are data concerning measurements and weights of nearly 300 beavers of various ages, collected since the date of the organization of the farms.

Size and Weight

As a measure for determining the age of a beaver we consider the weight of animals within a limit of accuracy of 50 gr. and some dimensions which can be taken exactly: the length of the head, from the occipital crest (crista occipitalis) to the tips of the nose; the length of the body from the occipital crest to the beginning of the bare part of the tail; the length of the bare part of the tail; its width; and the length of the hind paw from the heel to the tip of the middle finger, excluding the claw. Comparing these dimensions, provided, of course, normal fatness, the age of a beaver up to two years can be determined fairly accurately. Due to the fact that in the Voronezh oblast, most females have their young at the end of April or in early May, May 1 is considered as the end of the first year and the date of transition from one age group to the other. Most of the information used for compiling this table of the categories of beavers has been obtained from the territory of the sanctuary and the reservations, during summer thinning, i.e. between July 1 and September 15; a qualification must therefore be introduced, viz., that the minimum and maximum indices for each group are only given for the summer and autumn periods (Tables 1 and 2).

TABLE I - Determination of the age of beavers (average indices, typical for mid-year).

	Length of head	Length of body	Length of tail	Length of paw	Weight (in kg.)
Cub (3-4 months)......	12.0	40	18	13	4.0
Yearling.............	14.5	56	25	16	10.0
Two-year-old.........	15.5	60	27	17	14.0
Adult (3 years and older)............	16.5	65	28	18	18.0
Old individuals, large in size......	18.0	74	32	19	27.0

TABLE II - Age categories of beavers, from measurements in cm. compiled on the basis of the measurement of 1,186 beavers, caught in the Sanctuary).

	Young animals									Sexually mature animals					
	Cubs			Yearlings			Two-year-olds			Three-year-olds			Adults		
	From	To	M	From	To	M	From	To	M	From	To	M	From	To	M
Length of head......	9.5	13	11.8	13	15	14.3	14	16	15.3	15.5	17	16.1	16	18	16.7
Length of body......	27	51	40.3	50	61	55.8	55	67	60.5	59	68	64.3	63	74	67.6
Length of tail......	11	22	18.2	20	27.5	24.6	23	30	26.8	25.5	30.5	28.1	26	32	29.2
Width of tail......	4	9	7.0	8.5	12.5	10.2	10	14.5	11.9	12	15	13.3	12	15.5	15.5
Length of hind paw..	9	15	12.8	15	17	16.2	16	18	17.3	16.5	19	17.8	17	19	18.1
Weight (in gr.)..	1,450	8,450	4,332	7,650	12,900	10,328	10,350	15,900	13,294	15,100	20,500	17,278	16,750	26,750	19,847

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Table 2 gives the limit indices for each age group of wild beavers, in the summer and autumn, also the arithmetical mean (M) of the total of all measurements in respect of a certain age. The values of M approximately coincide with the measurements of beavers caught in August-September. It follows that, for determining the age of beavers at the beginning or end of a year, the indices given in the table must be adjusted, depending on the month. The sex of the animal must also be considered, for the females are usually larger than the males and the fatness of the animal must be taken into consideration. Thus, the age of beavers can be determined accurately only up to two years; after that the difference in age is so little noticeable that it is of no practical importance; therefore all older age groups had to be lumped together under the name of "adult animals".

The question how long a beaver lives has not yet been sufficiently studied. Brehm, Rossmessler (1867) assert that the beaver lives up to 50 years; other authors (Seton and Warren, Flower) assumed a considerably shorter life span - 12-15 years; Millet found a beaver not less than 22 years old, and one beaver spent in Nymphenburg, Bavaria, 33 years in captivity, another 35 years (Grawe, 1931).

There are some beavers on the farm of the Voronezh Sanctuary which are already 16-17 years old, one of them even 19 years. All those oldest animals are the best specimens of the farm, they propagate annually, and there are no indications of senility and aging.

Growth and Replacement of the Molars of Young Beavers, During the First Year of Life

It is much easier to determine the age of young beavers during their first year of life as the eruption and growth of the molars and the replacement of the milk pre-molars are subject to firm regularity.

We give below some data on the eruption and formation of the molars as observed in young beavers born on the farm. (Table III)

The beaver's incisors develop during the embryonic period, and a newly born beaver has its lower incisors already cut through; the upper incisors which are generally shorter, are in some specimens covered at first by a thin pellicle; on the first day of life or not later than on the second day, this pellicle disappears. Some cubs are born so well developed that the incisors are fully visible in both jaws.

An adult beaver has 20 teeth, the dental formula being:

$$I\,\frac{1}{1}\quad P\,\frac{1}{1}\quad M\,\frac{3}{3}$$

Immediately after the incisors, two pairs of milk pre-molars erupt, which are later replaced by the permanent pre-molars.

TABLE III - Development of the upper molars of newly-born beavers (number of days from birth).

Specimen number	1st pre-molar (milk)		1st molar		2nd molar		3rd molar	
	Beginning of eruption	Fully formed	Beginning of eruption	Fully formed	Beginning of eruption	Fully formed	Beginning of eruption	Fully formed
1	-	-	-	-	-	-	-	160
2	-	-	-	-	-	-	-	156
3	-	-	-	-	-	-	-	156
4	-	-	-	-	-	-	145	160
5	-	22	-	-	-	110	145	156
6	-	-	-	-	-	110	145	156
7	16	-	-	-	-	91	126	160
8	15	21	26	45	60	96	126	160
9	15	21	26	-	60	96	126	160

The first pre-molar (milk) tooth erupts on the lower jaw 15-18 days after birth; then gradually a tooth in the upper jaw begins to erupt and by the 20th-21st day it is fully cut. The teeth in the lower jaw grow faster, they always outgrow the corresponding teeth of the upper jaw. At the age of one month, young beavers usually have already two fully grown molars in the lower and one molar in the upper jaw. From that time on, they gradually begin to eat grassy food.

By the end of lactation, i.e. at the age of almost two months, the cubs have three molars in the lower and two molars in the upper jaw (Table 4). By that time, they can already masticate tender leaves and even shoots.

All four molars in the upper jaw are fully grown only after 5-5.5 months, i.e. about October-November. When all four molars have cut, the first pre-molar (milk) begins gradually to wear off (Fig. 1).

A pre-molar in a young beaver is replaced by constantly being ground away from above while not growing from beneath, until it is reduced to half size. Being held in the gum by its forked root and propped up all the time by the new tooth, it eventually begins to crumble, and at 8-9 months its remains have disappeared. But the new pre-molar is not fully formed yet; it completes its development only at 10 months, i.e. in February or March. As we see, there is a distinct relationship between the age of young beavers and the cutting of the molars and the replacement of the milk teeth. These clues enable us to determine with relative ease the age of a beaver cub within a limit of accuracy of 15 days.

In conclusion we give a table for determining the age of young beavers in their first year. The table is compiled as a result of analysis of above data regarding the replacement and growth of the molars (Table 5). We also show drawings of the molars during various, most typical stages of development (Fig. 2).

Dimensions and Structure of the Skull

Beside the methods of determining the age of live beavers, which have been described above, we recommend a method of determining the age of the dead animals by the general dimensions of the skull, the size of certain bones, and the degree of coalescence of the os parietale and the formation of the crest, which is of special importance for the morphological processing of materials and the determination of individual skulls and skeletons found in the field.

TABLE IV - Replacement of milk pre-molar in the upper jaw of young beavers (number of days from birth)

Specimen number	Beginning of wear of milk tooth	Milk tooth reduced to one-half size	New tooth first visible	Milk tooth reduced 1/4 size	Permanent tooth one-half size of old	Milk tooth crumbling	Permanent tooth reaches 3/4 of height	Milk tooth gone	Permanent not fully developed	Permanent fully developed
1	170	190	200	220	240	230	250	240	260	290
2	165	185	195	225	225	245	245	285	255	295
3	165	185	195	215	245	245	255	275	275	295
4	170	180	200	220	-	-	-	-	-	-
5	165	185	205	215	245	240	255	245	275	295
6	165	185	205	230	245	265	265	275	285	295
Average	167	185	200	221	240	245	254	264	270	294

TABLE V - Determination of the age of young beavers by the molars in the upper jaw.

Stages of development	Age (in months)
Milk premolars begin to erupt	0.5
Full eruption of milk premolars	1.0
Eruption of first molar	1.5
" " second molar	3.0
" " third molar	5.0
Milk premolars begin to wear	5.5
Cutting of permanent premolars	6.5
1/4 old and 3/4 new	7.5
Remains of old, 3/4 of new	8.5
Old tooth gone, new not yet fully developed	9.0
Full development of permanent premolars	10.0

Below we give a table of skull dimensions, compiled on the basis of a study of 67 skulls of beavers of various ages in the scientific collection of the Sanctuary. For the purpose, we took the following most convenient and typical dimensions of the skull and its individual bones: 1. general length of the skull; 2. jaw width; 3. space between the eyes, at its narrowest immediately before the jaw appendices of the frontal bone; 4. length of the nasal bones (os nasale); 5. zygomatic process of the temporal, which we measured from its posterior apex to the anteriormost point of its suture with the squamoral. (Table VI).

It is of interest to mention that among the skulls studied we found two which, according to all data, belonged to very old individuals. The dimensions of their skulls proved much longer than the average for adult beavers, and larger than the skull of a seven-year-old beaver which, in his lifetime, was one of the largest of the farm.

Thus, the general length of both skulls attained 150 mm. The jaw width was 109 mm. in one, and 106.5 mm. in the other. The space between eyes was respectively 30 and 31 mm., the length of the nasal bone 62.5 and 63 mm., and the jaw appendix 24.5 and 25 mm. respectively.

The type, structure and dimensions of the beaver's skull provide a good idea of category of age and permit rather accurate determination of the age of a beaver. An especially good clue is the size of the external sagittal crest and, partly, that of the cervical crest. (Fig. 3).

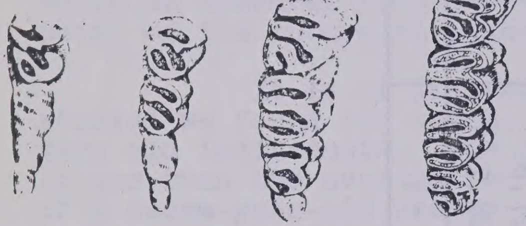
In the first months of life of a young beaver, the bones forming the brain-case are smooth and round, but after six months, from a weakly expressed cervical crest the external sagittal crest begins to grow; for the time it embraces only part of the os inter-parietale. Then, gradually flattening the os inter-parietale and switching it in the direction of its growth, the crest at the age of 4-5 years, takes it up completely, passing on to the sinciputal bones, retracting and thickening the commissure between them, narrowing every year the platform along the commissure of the sinciputal bone, formed by the V-shaped salient line which joins the jaw appendixes of the frontal bones to the cervical crest. In very old specimens whose skulls we saw, the external, sagittal crest had so grown that it covered 1/3 of the frontal bones, i.e. reached up to the centre of the skull.

Conclusions

1. The basic criteria for determining the age of a live beaver aged one year or over, are the dimensions of the principal parts of its body, especially of the head, and its weight.

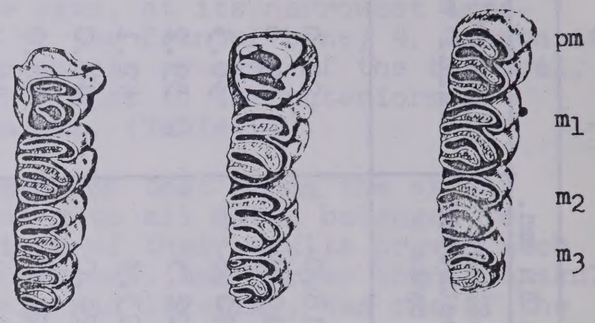
TABLE VI - Dimensions of the skull and some skull bones depending on age.

Age	Number of skulls	Dimensions in mm.				
		General length of skull	Jaw Width	Space between eyes	Length of nasal bone	Length of jaw appendix of temporal bone
A few days after birth...	4	68.0	47.5	18.0	22.0	6.3
1.5 months.....	2	83.5	50.5	19.8	29.0	9.0
3 months	6	93.9	65.5	20.8	36.3	11.5
4 months	4	99.0	71.2	22.3	39.2	13.3
5.5 months	9	104.0	76.4	23.3	42.1	14.1
7.5 months.....	2	113.5	81.8	24.0	44.0	16.3
9 months.......	2	116.5	83.0	24.8	46.0	16.5
1.5 years	7	119.1	86.5	24.9	49.7	17.5
Two-year-old...	12	132.5	96.0	27.4	56.5	21.1
Three-year-old.	4	136.3	98.3	27.8	57.6	22.1
Adult.........	15	144.2	103.7	28.7	60.7	24.0
Total	67	-	-	-	-	-



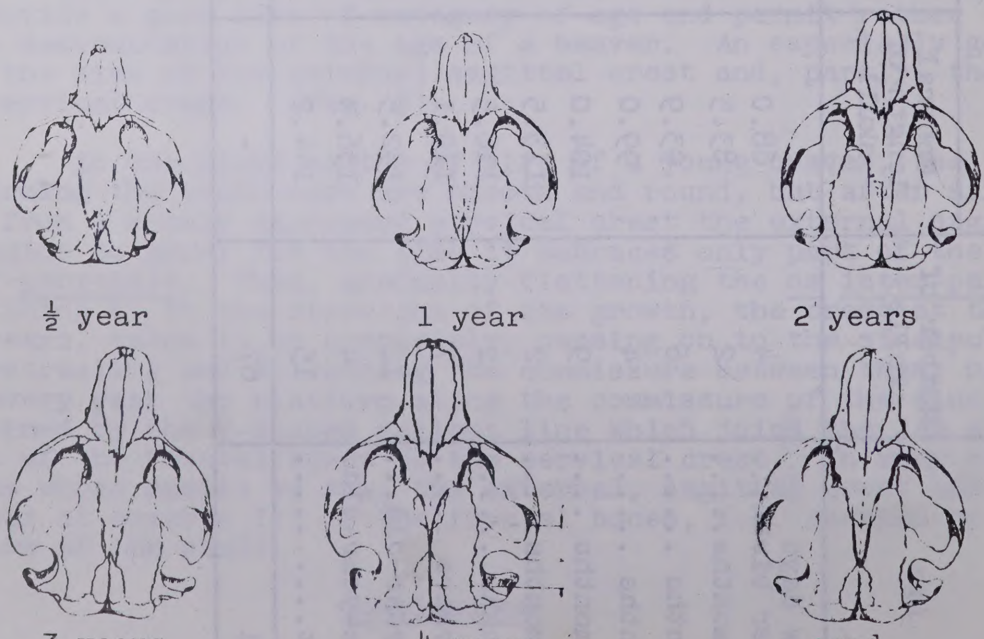
1 mo. 2 mo. 3 mo. 5 mo.

Fig. 1. Growth and replacement of the upper molars of young beavers during the first period of development (summer-autumn).



7 mo. 9 mo. 10 mo.

Fig. 2. Growth and replacement of the upper molars of young beavers during the second period of development (autumn-winter).



½ year 1 year 2 years

3 years 4 years aged

Fig. 3. Skull structure changing with age.

2. Knowing the dimensions of the hind paw at various ages, one is able to determine with some accuracy the age of the animals from their footprints, often found in mud and dirty snow.

3. The age of the cubs (up to 10 months) must be determined by the number, replacement and condition of the molar and premolar teeth.

4. The age of dead beavers may be determined by the dimensions of their skulls, some skull bones and the size of the external sagittal crest.

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